Laird Audio Development Kit (ADK)
User Guide

Part # DVK-BTM511
Applicable to the following Bluetooth module part numbers:

- BTM511 – Revision 07 and later

global solutions: local support

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Embedded Wireless Solutions Support Center: http://ews-support.lairdtech.com
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LAIRD AUDIO DEVELOPMENT KIT (ADK)

Part #	DVK-BTM511 Applicable to the following Bluetooth module part numbers: BTM511 Revision -07 onwards

1. OVERVIEW

Laird's Audio Development Kit (ADK) provides a platform for rapid wireless connectivity prototyping, providing multiple options for the development of Bluetooth stereo and mono audio applications.

This manual is for the first production release of the development board PCB and relates to **BTM511 DVK-V04** on the PCB itself. The complete functionality of the ADK hardware requires the use of Laird BTM511 firmware revision -07 (firmware v18.1.3.0) or greater.

1.1 Introduction

The Laird ADK is designed to support the rapid development of applications and software for the specific Laird Bluetooth module part number BTM511. More information regarding this product including a detailed module User's Manual is available from the following link: http://www.lairdtech.com/products/btm51x-series.

1.2 Package Contents

All kits contain the following items:

Development Board	The motherboard has the BTM511 module already soldered onto it and exposes all the various hardware interfaces available.
USB cable – Type A to Type B	The USB cable is one option for providing power for the ADK via the on-board connector. The cable also provides serial communications via a FTDI USB – RS232 converter chip.
3.5 mm Audio cable	The audio cable is one option for connecting one of the Line in / MIC / Speaker ports to an external media device with 3.5mm audio jack socket.
Web link Card	Provides links to additional information including the BTM511 User Manual, terminal utilities, schematics, quick start guides and firmware release notes.

2 ADK – Main Development Board

The development board allows the Laird Bluetooth module to connect to a PC. The development board provides USB-to-Virtual COM port conversion through a FTDI chip. Any Windows PC (XP or later) auto-installs the necessary drivers; if your PC cannot locate the drivers, you can download them from http://www.ftdichip.com/FTDrivers.htm

3 Getting to know the Development Board

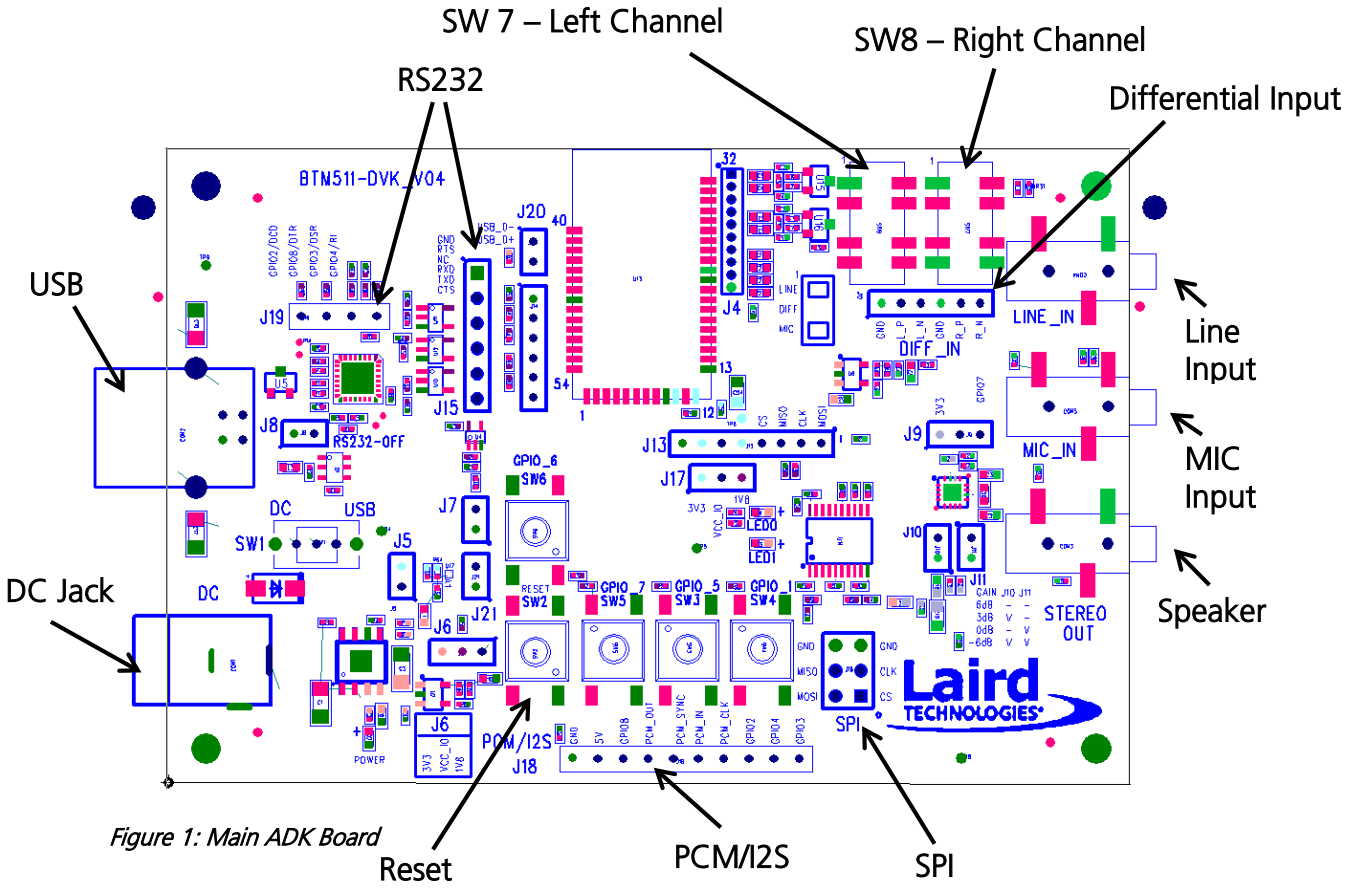


Figure 1: Main ADK Board

4 Power Supply

	Minimum	Typical	Maximum
Input Voltage	4.5 V	5 V	5.5 V

The development board has two options for providing power to the module:

- 5V power from a USB port
- Power from an external mains power block via a 2.0 mm DC connector

The developer kit includes a USB cable to provide power to the development board. It should be plugged into a PC USB port, a USB hub, or a mains adaptor with a USB output. If a hub is used, it should be a powered USB hub to ensure that sufficient current is available at the port being used. The BTM511 module can be driven by the current available at a standard USB port.

Switch SW1 is used to select between USB or DC jack power source.

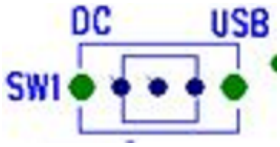


Figure 2: SW1 Settings

SW1 (slide switch) provides the selection of input power for BTM511 module from USB or DC jack. The power for the U3 (FT232R) is always powered by the USB bus.

SW2 (push button TACT switch) provides a reset signal to the BTM511 module.

5 USB - RS232 SERIAL INTERFACE

The ADK provides USB-to-Virtual COM port conversion through a FTDI chip and any Windows PC (XP or later) will auto install the necessary drivers and if your PC cannot locate the drivers, you can download them from http://www.ftdichip.com/FTDrivers.htm

The development board contains a USB to UART interface on the RX, TX, CTS, RTS, DTR, DSR, RI, and DCD signals. In default setting, the FTDI is on by having the J8 open (no jumper), so providing a USB to virtual COM port for evaluation through standard USB cable. See Figure 3.

The UART interface on the BTM511 module can be driven from external microcontroller instead of the on-board FTDI FT232R chip (U3), if the DVK is powered from DC jack and SW1 (Figure 2) is in position 'DC'. At a minimum, RX, TX, RTS, and CTS need to be connected (J15) for this use case. Modem control lines (J19) are optional.

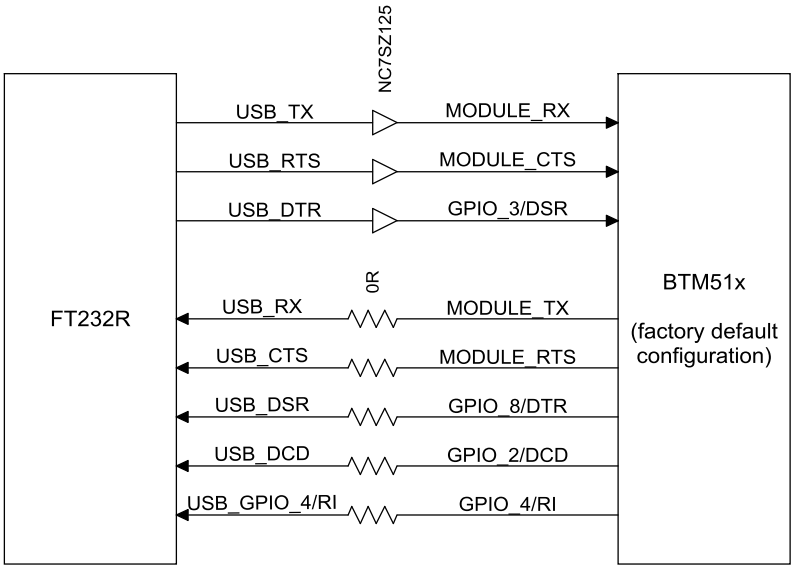


Figure 3: USB to UART Interface

6 SOFTWARE

The development board connects the BTM511 module to a virtual COM port of a PC or other device. From a PC, you can communicate with the module using any Terminal Emulator software, such as HyperTerminal, Procomm, or the supplied EZURiO / Laird Terminal application.

EZURiO / Laird Terminal is a terminal emulation application capable of running on Windows 98, Me, 2000, XP, Windows 7 and Windows 8 operating systems. It was developed specifically to aid development and testing of Laird modules. It allows connection to serial devices using any combination of the communications parameters listed in Table 1.

Table 1: Communication Parameters

COM Port	1 to 255
Baud rate	300 to 921600
Parity	None, Odd, Even
Data Bits	7 or 8
Stop Bits	1 or 2
Handshaking	None or CTS/RTS

The benefits of using EZURiO / Laird Terminal include:

- Continually displayed status of DSR, CTS, DCD, and RI
- Direct control of DTR on the host PC via a check box
- Direct control of RTS
- Sending of BREAK signals
- Scripts can be run to assist
- Additional built-in features accelerate development

Laird includes a "Data Transfer Test" mode allowing data to be sent as fast as the handshaking permits. This feature is useful for testing the bit transfer rate of a Bluetooth connection.

The EZURiO / Laird Terminal application can be downloaded from the Software Downloads tab of the BTM51x webpage: http://www.lairdtech.com/products/btm51x-series. You will need to login or register for access.

7 INTERFACE SPECIFICATION

7.1 RS232 Serial signals

The digital RS232 Serial signals are contained in J15/J19 as shown in Table 2.

Note: The direction is from the module's perspective.

Table 2: RS232 Definitions

J15	Signal	J15 Description	Direction	Shared with
Pin-1	GND	Ground	-	-
Pin-2	RTS	Request To Send	Output	-
Pin-3	NC	No Connection	-	-
Pin-4	RXD	Receive Data	Input	-
Pin-5	TXD	Transmit Data	Output	-
Pin-6	CTS	Clear To Send	Input	-

J19	Signal	J19 Description	Direction	Shared with
Pin-1	DCD	Data Carrier Detect	Output	GPIO2
Pin-2	DTR	Data Terminal Ready	Output	GPIO8
Pin-3	DSR	Data Set Ready	Input	GPIO3
Pin-4	RI	Ring Indicator	Output	GPIO4

The format of the holes allows the fitting of your choice of connectors, or can be used for directly soldering test wires to the board. Pins are laid out on a standard 2.54 mm (0.1 inch) pitch.

7.2 PCM / I2S

The development board provides for a PCM / I2S interface for the BTM511. The pins provide the developer with access to the module's I2S or PCM lines, as well as providing power for additional audio hardware to be developed.

I2S signals are mapped to the PCM pins of BTM51x as outlined in this table:

Table 3: BTM51x pins and I2S Signals

I2S Signal Name	BTM51x Signal Name	BTM51x Module Pin Number	ADK Header (J18)	Comment
SD_IN	PCM_IN	3	5	I2S Serial data in
SD_OUT	PCM_OUT	4	7	I2S Serial data out
WS	PCM_SYNC	5	6	I2S Word select (right/left ch)
SCK	PCM_CLK	6	4	I2S clock
	GND1/2/3/4	[9,22,13,47]	10	GND

Note: For backward compatibility reasons, remaining pins of J18 are connected to signals that are not directly related to PCM/I2S functions.

7.3 Differential input – J12 on ADK, labeled DIFF_IN

If the audio input should be driven by a differential audio source rather than a single-ended signal, J12 allows connecting non-inverted ('P') and inverted ('N') signal of the source to BTM511, as well as AGND (analogue GND) for left and for right channel. In addition, SW7 and SW8 must be set to middle position "DIFF".

Differential signals provide better audio quality due to better noise immunity.

7.4 SPI Interface - J16 on ADK, labeled SPI

This interface is only utilized for Laird's internal use and production testing. We do not recommend that the OEM use these pins.

Note: J14, J13 (labelled SPI/VCC) and J4 are similarly only used for Laird internal use in manufacturing test.

7.5 Audio Connectors – Labeled LINE_In, MIC_IN and STEREO_OUT

These 3.5 mm audio connectors on the right side of the ADK allow OEMs to connect standard speakers, microphones and headphones.

7.6 Push Buttons

Table 4: Push buttons

Push Button	Label on ADK PCB	Description
SW2	RESET	Button to reset the BTM511 module
SW3	GPIO 5	Push button for use of associated GPIO line for a range of configurable functionality
SW4	GPIO 1	Push button for use of associated GPIO line for a range of configurable functionality
SW5	GPIO 7	Push button for use of associated GPIO line for a range of configurable functionality **Note:** Contrary to remaining push buttons, the pull-up resistor (R29) for GPIO 7 is not fitted per default. In future use, GPIO7 may function as an output to control the audio amplifier (U7), see J9.
SW6	GPIO 6	Push button for use of associated GPIO line for a range of configurable functionality

7.7 Board Configuration Jumpers

Table 5: Jumpers

Jumper	Label on ADK PCB	Description
J1 – J3	N/A	Unused on the development board.
J4	J4	INTERNAL USE ONLY.
J5	J5	Provides provide voltage drop on 3.3 V across 0.25 ohm to measure the current for the BTM511 module when open.
J6	J6	Place a jumper on the middle and left side pins for 3.3 V operation. Place a jumper on the middle and right side pins for 1.8 V operation.
J7	J7	INTERNAL USE ONLY.
J8	J8 RS232-OFF	Default state is J8 open (no jumper) for use with USB power and on board FTDI. Alternatively, the UART interface on the BTM511 module can be driven from external microcontroller instead of the on-board FTDI FT232R chip (U3) by powering the DVK via DC jack and setting SW1 (Figure 2) to 'DC'. At a minimum RX, TX, RTS, CTS and GND need to be connected (J15) for this use case.
J9	J9 3.3V GPIO7	Place a jumper on the middle and left side pins to set audio amplifier enabled pin to 3.3 V. Place a jumper on the middle and right side pins to set audio amplifier to be controlled by GPIO-7. **Note:** This second option is not implemented in current firmware version 18.1.3.0.
J10	J10	Place jumper across J10 / J11 (closed) to select audio amplifier gain as listed on silkscreen table below J11.
J11	J11	Place jumper across J10 / J11 (closed) to select audio amplifier gain as listed on silkscreen table below J11.
J12	DIFF_IN	Differential stereo audio input.
J13	J13	INTERNAL USE ONLY.
J14	N/A	INTERNAL USE ONLY.

Jumper	Label on ADK PCB	Description
J15	J15	Through hole plated UART interface for use when direct access to the UART pins from an external microcontroller. UART pins supported on J15 are GND, RTS, NC, RXD, TXD, CTS. Additional UART lines on J19. Please see notes on J8.
J16	SPI	INTERNAL USE ONLY.
J17	J17 3V3 1V8	Place a jumper on left hand side and middle pins to set VDDIO to 3.3 V. Place a jumper on middle and right hand side pins to set VDDIO to 1.8 V.
J18	PCM / I2S	Please see the PCM / I2S section.
J19	J19	Through hole plated UART interface (modem control lines) for use when direct access to the UART pins from an external microcontroller is required. UART pins supported on J19 are DCD, DTR, DSR and RI. Additional UART lines on J15. Please see notes on J8.
J20	USB_D+ USB_D-	USB access can be provided to allow a direct USB connection to a Bluetooth HCI module. **Note:** If this is done and the unit is connected to a USB host port, it will be powered from that same port. Do not attempt to use any other power source for the development kit when operating in this mode. This is not relevant for modules with a UART interface.
J21	J21	Do not close J21 by placing a jumper. J21 is not fitted by default to prevent a short circuit caused by accidentally closing the headers with a jumper. Full details are available in Section 8.1

7.8 SW – Switches

SW1 Is the power switch on board the BTM51X DVK. Its function is explained in Table 6.

Table 6: SW1 Position

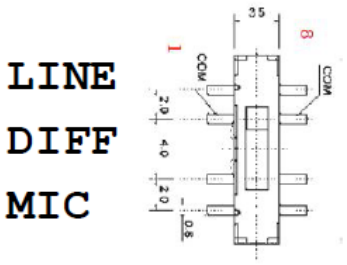
Switch	Label on ADK PCB	Description
SW1	DC USB	Switch to select power input from DC jack or USB connector.

SW7 and SW8 control which input lines are connected to the BTM510 / 511 module. The positioning of the switch determines whether the channel is placed in Line, Diff, or Mic mode and therefore what signal lines are connected. Table 7 explains the function of SW7 and SW8.

Table 7: SW7 and SW8 positions

SW8 Position (Left Channel)	BTM511 Input Signals	
	MIC_AN_C	MIC_AP_C
LINE (Top)	CON4-2 (Line_IN)	AGND
DIFF (Middle)	J12-3 (DIFF_IN / L_N)	J12-2 (DIFF_IN / L_P)
MIC(Bottom)	CON5-2 (MIC_IN)	CON5-1 (MIC_IN / AGND)

SW7 Position (Right Channel)	BTM511 Input Signals	
	MIC_BN_C	MIC_BP_C
LINE (Top)	CON4-3 (Line_IN)	AGND
DIFF (Middle)	J12-6 (DIFF_IN / R_N)	J12-5 (DIFF_IN / R_P)
MIC(Bottom)	AGND	AGND



8 Other Features

8.1 Power Consumption Measurement

J21, pin 2 provides the output voltage of current sensing amplifier U17 (INA216A4). Current is measured by voltage drop over the parallel resistors R64, R65 (0.51 Ohm each). R64 and R65 can be seen as one 0.255 Ohm resistor. With the gain of U17, which is 200, the following formula results:

I = ((voltage_J21 / 200) / 0.255) A

Or simplified:

I = (voltage_J21 / 51) A

Note 1: The parameters of this DVK are optimised for measuring average low currents. If the intention is to measure current patterns (e.g. for sniff mode investigation, higher currents), the bandwidth of this design (response to fast changing currents) is insufficient. In that case, a current-sensing amplifier with less gain but higher bandwidth should be utilised (see INA216A data sheet). J5 allows to do this externally.

Note 2: This only measures the current consumption of the module, and not of the level shifter or other peripheral circuitry.

8.2 USB Access

USB access can be provided to allow a direct USB connection to a Bluetooth HCI module. To enable this operation, close J8 by placing a jumper on the pins.

If this is done and the unit is connected to a USB host port, it will be powered from that same port. Do not attempt to use any other power source for the development kit when operating in this mode.

Note: This is not relevant for modules with a UART interface.

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9 ADDITIONAL DOCUMENTATION

Laird offers a variety of documentation and ancillary information to support our customers through the initial evaluation process and ultimately into mass production. Software and documentation are available on the BTM51X product page at http://www.lairdtech.com/products/BTM51X-series. Additional documentation includes:

- BTM511 – Class 2 Audio Multimedia Module – Datasheet
- BTM510 / 511 – User Manual
- Firmware Release Notes – BTM510 / 511 to v18.1.x.x
- ADK – Audio Development Kit - Schematics
- BTM511 – ADK – Quick Start Guide – A2DP & AVRCP
- BTM511 – ADK – Quick Start Guide – HFP
- BTM511 – ADK – Quick Start Guide – SPP

For any additional question or queries or to receive local technical support for the ADK or BTM511 module, please contact wirelessinfo@lairdtech.com.

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